IN THE SPECIFICATION

Please amend the paragraph beginning at page 2, line 16 to page 3, line 4, as follows:

The conventional high sensitivity radio receiver shown comprises the antenna 1 which is formed by four antenna elements 1a, 1b, 1c and 1d, an element feeder line 2 (2a, 2b, 2c and 2d) connected to each antenna element, a reception phase shifter 14 formed by reception phase shifter circuits (14a, 14b, 14c, 14d) which adjust for phase differences between received signals from respective element feeder lines, reception bandpass filter means (RXF3) including filters (3a, 3b, 3c, 3d) which select and pass signals in desired reception bands from the outputs from the reception phase shifter circuits 14a, 14b, 14c and 14d, a low noise reception amplifier (LNA) 4 (formed by amplifier sections 4a, 4b, 4c, 4d) which provides a low noise amplification of respective outputs from RXF3 to desired levels, a ~~synthesizer~~ combiner 15 for ~~synthesizing~~ combining outputs from individual sections of LNA4, LD5 which converts an output from the ~~synthesizer~~ combiner 15 into an optical signal, a reception output port 6 which delivers the output signal from LD5, a transmission line 20 formed by an optical fiber cable and O/E 21. The reception phase shifter 14, RXF3, LNA4, the ~~synthesizer~~ combiner 15 and LD5 are contained in a casing 7.

Please amend the paragraph at page 3, lines 5-26, as follows:

The reception phase shifter 14 is constructed as illustrated in Fig. 3, for example. Received signals having a wavelength $\lambda$ which are incident with an angle of depression $\theta$ arrive at the antenna with a phase difference of

$$2\pi d \sin\theta / \lambda$$

between adjacent antenna elements which are spaced apart by a spacing d. (In the example shown in Fig. 3, the received signal has a lagging phase which increases in a direction from 1d toward 1a.) Accordingly, received signals from the antenna elements 1b, 1c and 1d are

~~synthesized~~ combined by sequentially adding a phase lag equal to $\Delta\Phi=2\pi d \sin \theta / \lambda$ thereto as referenced to the received signal of the antenna element 1a. Accordingly, when the signals are incident in the direction indicated by the angle of depression $\theta$, the received signals from individual antenna elements are ~~synthesized~~ combined at an equal phase to achieve a strongest reception, thus allowing the center of the antenna beam to be directed in the direction indicated by the angle of depression $\theta$. In a mobile communication base station system, a design may be employed so that the reception sensitivity of the base station with respect to a signal transmitted from a mobile station which is located within the service area of the base station be increased by sloping the center of the antenna beam toward the ground surface. While not shown in Fig. 3, where the antenna 1 is also used as the transmitting antenna, the center of the transmitting antenna beam of the base station may be sloped toward the ground surface in order to reduce radio interferences with adjacent areas.

Please amend the paragraph beginning at page 3, line 27 to page 4, line 6, as follows:

The received signal delivered from the ~~synthesizer~~ combiner 15 of the conventional receiver shown in Fig. 2 is converted into an optical signal by LD5 in the similar manner as shown in Fig. 1 and the optical signal is, conveyed on the transmission line 20, and converted into an electric signal again by O/E21 to be delivered as received signals by amplifier sections (4a to 4D), which are fed with an operating power from power terminals 50a to 50d.

Please amend the paragraph at page 4, lines 7-22, as follows:

A high sensitivity radio receiver which is provided with an array antenna may be cooled to improve the reception sensitivity as disclosed in U.S. Patent No. 6,480,706, for example. Specifically, as illustrated in broken lines in Fig. 2, the reception phase shifter 14, RXF3, LNA4 and the ~~synthesizer~~ combiner 15 may be contained in a heat shielding box 8 in

the similar manner as the high sensitivity receiver shown in Fig. 1 to be cooled by cooling means 9 so as to be maintained at a given temperature. The cooling means 9 includes a cold head having a cooling member 9a which is formed by a copper plate and on which the reception phase shifter 14, RXF3, LNA4 and the ~~synthesizer~~ combiner 15 are mounted. The reception phase shifter 14, RXF3 and the like are formed by a superconducting material which assumes a superconducting state upon cooling, and are cooled by the cooling means 9 until the reception phase shifter 14, and RXF3 and the like assume a superconducting state and are maintained at such temperature, thus achieving a drastic reduction in the circuit loss. An operating power to the cooling means 9 is fed from a power terminal 90.

Please amend the paragraph at page 9, lines 26-27, as follows:

Fig. 23 is a block diagram showing another example of phase shift ~~synthesizer~~ combiner 16 shown in Fig. 22;

Please amend the paragraph at page 23, lines 4-16, as follows:

An antenna 1 is formed by four antenna elements 1a to 1d, in the similar manner as in the conventional receiver shown in Fig. 2. However, a reception phase shifter 14, RXF3, LNA4, a ~~synthesizer~~ combiner 15 and LD5 which are constructed in the similar manner as shown in Fig. 2 are confined in this embodiment in a heat shielding box 8 which is provided with vacuum heat insulation to interrupt the heat flow from the outside into the box, and are cooled by cooling means 9 which is capable of maintaining a very low temperature, which may be several tens K , for example, in a stable manner for a prolonged period of time. Thus, in this embodiment, cooling means 9 which is similar to that described in connection with the embodiment shown in Fig. 5 is used, and the reception phase shifter 14, RXF3, LNA4, the

~~synthesizer~~ combiner 15 and LD5 are mounted on the cooling member 9a of the cooling means 9, and thus is cooled by a single cooling unit.

Please amend the paragraph beginning at page 23, line 17 to page 24, line 3, as follows:

When the reception phase shifter 14, RXF3, LNA4, the ~~synthesizer~~ combiner 15 and LD5 are cooled to cryogenic temperature in a stable manner for a prolonged period of time, thermal noises which may be generated within these devices may be minimized and since the reception phase shifter 14 and RXF3 assume a superconducting state, their insertion loss can be minimized. As a consequence, the noise figure of the array antenna high sensitivity radio receiver is significantly improved as is the reception sensitivity. Thus, when this high sensitivity receiver is used, a received output with a prescribed C/N ratio can be obtained from a low level received signal, and a transmitting power on the transmitting side which is required to obtain a received output having a prescribed C/N ratio can be reduced. In addition, when the heat shielding box 8 is evacuated, a frosting on LD5 as a result of the sublimation of a water vapor in the air can be prevented when LD5 is cooled to a cryogenic temperature.

Please amend the paragraph at page 24, lines 4-11, as follows:

Fig. 18 shows another embodiment in which the cooling means 9 for the array antenna high sensitivity receiver is constructed in the similar manner as illustrated in Fig. 7 using a heat resistance member. Thus, a distinction of this embodiment over the arrangement shown in Fig. 17 resides in the fact that the reception phase shifter 14, RXF3, LNA4 and the ~~synthesizer~~ combiner 15 are directly cooled by a cooling member 9a to a first temperature

while LD5 is cooled to a second temperature through the cooling member 9a and a heat resistance member 10-1.

Please amend the paragraph at page 25, lines 8-23, as follows:

The temperature which is preferred for LD5 may be different from the temperature which is preferred for the reception phase shifter 14, RXF3, LNA4 and the ~~synthesizer~~ combiner 15 as mentioned above. Accordingly, in this embodiment, a condition in which the reception phase shifter 14, RXF3, LNA4 and the ~~synthesizer~~ combiner 15 are stabilized at the first temperature is implemented by the cooling means 9 while a condition in which LD5 is stabilized at the second temperature which is higher than the first temperature is implemented by interposing the heat resistance 10-1 between LD5 and the cooling member 9a. In this instance, a required offset between the first and the second temperature can be realized by a suitable choice of the thermal conductivity and the configuration of the member which constitutes the heat resistance member 10-1. The present embodiment can be considered such that the devices are separated into two groups, one including the reception phase shifter 14, RXF3, LNA4 and the ~~synthesizer~~ combiner 15 and the other including LD5, the first group being cooled by the cooling unit 91 while the second group is cooled by the cooling unit 92.

Please amend the paragraph beginning at page 25, line 27 to page 26, line 5, as follows:

A distinction of this embodiment over the arrangement shown in Fig. 17 resides in the fact that LD5 is directly cooled to a second temperature by a cooling member 9a (cooling unit 91) while the reception phase shifter 14, RXF3, LNA4 and the ~~synthesizer~~ combiner 15 are

cooled to a first temperature which is higher than the second temperature by the cooling unit 92 or through a heat resistance member 10-2.

Please amend the paragraph at page 26, lines 9-13, as follows:

A distinction of this embodiment over the arrangement shown in Fig. 18 resides in the fact that the reception phase shifter 14, RXF3, LNA4 and ~~synthesizer~~ combiner 15 are inclusively cooled to a first temperature by first cooling means 9-1 while LD5 is cooled to a second temperature by second cooling means 9-2.

Please amend the paragraph at page 26, lines 17-22, as follows:

A distinction of this embodiment over the arrangement shown in Fig. 20 resides in the use of two member cooling means 9'. Specifically, the reception phase shifter 14, RXF3, LNA4 and the ~~synthesizer~~ combiner 15 are inclusively mounted on a first stage 9s1 of the two member cooling means 9' while LD5 is mounted on a second stage 9s2 of the two member cooling means 9' to be cooled to a second temperature.

Please amend the paragraph beginning at page 26, line 23 to page 27, line 23, as follows:

Various forms of the cooling means 9 for the array antenna high sensitivity receiver have been shown, including an example in which a heat resistance member is used to define a plurality of cooling units 91, 92, another example in which a plurality of cooling means are used to define a plurality of cooling units 91, 92, and a further example in which cooling means having a plurality of members is used to define a plurality of cooling units 91, 92. Cooling the reception phase shifter 14 and RXF3 on one hand and LNA4, the ~~synthesizer~~ combiner 15 and LD5 on the other hand to mutually different temperatures using cooling

means 9 which includes a plurality of cooling units 91 and 92 or 91, 92 and 93 which are constructed using various techniques without being limited to the examples shown above can be implemented in the similar manner as in the embodiments shown in Figs. 8, 10A, 13 and 15. Alternatively, cooling the combination of the reception phase shifter 14 and RXF3, the combination of LNA4 and the ~~synthesizer~~ combiner 15 and LD5 to mutually different temperatures is also possible in the similar manner as in the embodiments shown in Figs. 9, 10C, 10D, 12 and 16. Generally stated, the reception phase shifter 14, RXF3, LNA4, the ~~synthesizer~~ combiner 15 and LD5 may be divided into two groups, which are cooled by different cooling units, or may be divided into three groups which are cooled by three cooling units or divided into four groups, which are cooled by four cooling units, or divided into five sections, which are individually cooled by five cooling units. In sum, in these embodiments and the embodiment shown in Fig. 17, devices on the signal path which are contained within the heat shielding box 8, namely, the reception phase shifter 14, RXF3, LNA4, the ~~synthesizer~~ combiner 15 and LD5 may be divided into s groups, which may be cooled by s cooling units where s is one of 1, 2, 3, 4 and 5, inclusive of an instance where these devices are separately cooled. A device within the heat shielding box 8 as termed herein refers to such device.

Please amend the paragraph beginning at page 27, line 24 to page 28, line 17, as follows:

By way of example, Fig. 29 schematically shows an example using heat resistance members to cooled devices within the heat shielding box 8 in three groups. The reception phase shifter 14 and the ~~synthesizer~~ combiner 15 are mounted on a cooling member 9a through a heat resistance member 10-1 to be cooled by a cooling unit 92, RXF3 and LNA4 are directly mounted on the cooling member 9a to be cooled by a cooling unit 91, and LD5 is

mounted on the cooling member 9a through an interposed heat resistance member 10-2 to be cooled by a cooling unit 93. The heat resistance member 10-1 comprises a heat resistance section 10-1a on which the reception phase shifter 14 is mounted, a heater resistance section 10-1b on which the ~~synthesizer~~ combiner 15 is mounted, and a heat resistance section 10-1c which connects between the both heat resistance sections 10-1a and 1b, and which are integrally formed together. In this manner, a combination of the reception phase shifter 14 and the ~~synthesizer~~ combiner 15, a combination of RXF3 and LNA4 and LD5 can be cooled to temperatures which are different from each other. It will be readily understood that where the devices are divided into other combinations or groups, the arrangement shown above is applicable not only to an arrangement in which a plurality of cooling units are formed by using a heat resistant member or members, but also to an arrangement where the plurality of cooling units are formed by a plurality of cooling members or where they are formed by a plurality of cooling means.

Please amend the paragraph beginning at page 28, line 20 to page 29, line 2, as follows:

As compared with the arrangement shown in Fig. 17, a distinction of this embodiment resides in the fact that received signals from antenna elements 1a, 1b, 1c and 1d are input to RXF3 (3a, 3b, 3c and 3d), and outputs from 3a, 3b, 3c, and 3d are amplified in four amplifiers (4a, 4b, 4c, 4d) of LNA4, and the amplified signals are subject to an adjustment for phase differences between them in four phase shifter circuits 14a, 14b, 14c and 14d of the reception phase shifter 14 so as to assume an identical phase before they are ~~synthesized~~ combined in the ~~synthesizer~~ combiner 15, and the ~~synthesized~~ combined output signal is delivered to LD, it being noted that the reception phase shifter 14 and the ~~synthesizer~~ combiner 15 are disposed outside the heat shielding box 8.

Please amend the paragraph at page 29, lines 3-11, as follows:

RXF3 and LNA4 are maintained at a cryogenic temperature by the cooling means 9, and accordingly, the phase response of RXF3 and LNA4 do not vary. Accordingly, the phase shifter 14 may be located subsequent to LNA4. When the reception phase shifter 14 and the ~~synthesizer~~ combiner 15 are disposed outside the heat shielding box 8, the thermal load on the cooling means 9 can be reduced. However, as indicated by dotted lines in Fig. 22, an arrangement where thermal noises which are generated within the reception phase shifter 14 and the ~~synthesizer~~ combiner 15 may be reduced may be used to achieve a further improvement in the reception sensitivity.

Please amend the paragraph beginning at page 29, line 20 to page 30, line 16, as follows:

In the embodiment shown in Fig. 22, the reception phase shifter 14 and the ~~synthesizer~~ combiner 15 forms in combination a phase shifter ~~synthesizer~~ combiner 16 which performs a phase adjustment and ~~synthesizing~~ combining. However, a phase shifter ~~synthesizer~~ combiner 16 may be constructed as shown in Fig. 23, for example. Specifically, an output signal from the amplifier 4a of LNA4 is input to a phase shifter circuit 14a, and an output signal therefrom and an output signal from the amplifier 4b are ~~synthesized~~ combined in a ~~synthesizer~~ combiner 15a. Then an output signal from the ~~synthesizer~~ combiner 15a is input to a phase shifter circuit 14b and an output signal therefrom and an output signal from the amplifier 4c are synthesized in a ~~synthesizer~~ combiner 15b. An output signal from the ~~synthesizer~~ combiner 15b is input to a phase shifter circuit 14c, and an output signal therefrom and an output signal from the amplifier 4d are ~~synthesized~~ combined in a ~~synthesizer~~ combiner 15c to be delivered to LD5. Other arrangement as exemplified in Fig. 2

of the drawings of the cited U.S. Patent may also be used for the phase shifter ~~synthesizer~~ combiner 16. In the embodiment shown in Fig. 22 also, devices on the signal path which are contained within the heat shielding box 8, namely, RXF3, LNA4, LD5 as well as the reception phase shifter 14 and the ~~synthesizer~~ combiner 15, if these devices are also used, may be divided into s groups, which may be cooled by s cooling units where s is an integer from 1 to 3 when the reception phase shifter 14 and the ~~synthesizer~~ combiner 15 are disposed within the heat shielding box 8, and is an integer from 1 to 5 when the reception phase shifter 14 and the ~~synthesizer~~ combiner 15 are disposed outside the heat shielding box 8. This will be readily understood from the technique illustrated in Fig. 29, for example.

Please amend the paragraph beginning at page 30, line 17 to page 31, line 4, as follows:

Fig. 24 shows an embodiment which illustrates the application of the present invention to an arrangement as disclosed in the cited U.S. Patent in which received signals from individual antenna elements are initially subject to a phase adjustment and ~~synthesis~~ combining before they are fed to LNA4. Received radio frequency signals from individual antenna elements 1a to 1d are initially subject to an adjustment of phase differences between the individual signals and to a ~~synthesis~~ combining in a phase shifter ~~synthesizer~~ combiner 16, whereby four received radio frequency signals are ~~synthesized~~ combined with an equal phase into a single radio frequency signal, which is fed to RXF3 comprising a single filter. The subsequent signal processing takes place in the similar manner as in the embodiment shown in Fig. 5. The phase shifter ~~synthesizer~~ combiner 16 is contained within the heat shielding box 8 and is cooled by cooling means 9. In this example, the phase shifter ~~synthesizer~~ combiner 16 is mounted on a cooling member 9a together with RXF3, LNA 4 and LD5 to be cooled to a common temperature by a single cooling unit.

Please amend the paragraph at page 31, lines 5-13, as follows:

In each of the embodiments shown in Figs. 7 to 16 and using cooling means 9 which includes a plurality of cooling units, the phase shifter ~~synthesizer~~ combiner 16 may be cooled by any cooling unit to a common temperature as other devices or may be cooled to a different temperature from other devices. It is important to know that it is not always necessary that the phase shifter ~~synthesizer~~ combiner 16 be cooled to the common temperature as RXF3. As indicated by dotted lines in Fig. 24, the phase shifter ~~synthesizer~~ combiner 16 may be disposed outside the heat shielding box 8 to reduce the load on the cooling means 9.

Please amend the paragraph beginning at page 31, line 14 to page 32, line 2, as follows:

Where the reception phase shifter 14, the ~~synthesizer~~ combiner 15 or the phase shifter ~~synthesizer~~ combiner 16 is contained within the heat shielding box 8, and is cooled to the common temperature as other device loated with the heat shielding box 8, it is cooled to the common temperature as RXF 3 and LNA4. Where it is cooled to a different temperature from LD5, the reception phase shifter 14 or the phase shifter ~~synthesizer~~ combiner 16 is cooled to the common temperature with RXF3. Where the ~~synthesizer~~ combiner 15 is cooled to the common temperature as LNA4 and/or LD5, the phase shifter ~~synthesizer~~ combiner 16 is cooled to the common temperature with LNA4 and/or LD5. Where it is cooled to a different temperature from RXF3, it is cooled by a corresponding one of the cooling units 91 to 93 depending on the requirement. Also in the embodiment shown in Fig. 24, devices within the heat shielding box 8 may be generally divided into s groups, which may be cooled by s cooling units where s is one of 1, 2, 3 and 4 when the phase shifter ~~synthesizer~~ combiner

16 is used, and is one of 1, 2, 3, 4 and 5 when both the reception phase shifter 14 and the ~~synthesizer~~ combiner 15 are used.

Please amend the paragraph at page 32, lines 3-11, as follows:

For any embodiment shown in Figs. 5 to 24, when the high sensitivity receiver is applied to a base station of a mobile communication system, for example, it is desirable that the antenna 1 of the high sensitivity receiver be used both for the reception and transmission in order to enable a compact and economic construction of a based station equipment. This can be realized by providing an antenna duplexer between the antenna feeder line 2 and RXF3 or between each feeder line 2a, 2b, 2c and 2d from the antenna elements and one of phase shifter circuits 14a, 14b, 14c and 14d or between the phase shifter ~~synthesizer~~ combiner and RXF3.

Please amend the paragraph beginning at page 32, line 25 to page 33, line 19, as follows:

Fig. 26A is an illustration when a radio frequency signal s(t) has a largest number of multiplexible channels. In this instance, s(t) has a high power level, and accordingly has a large maximum amplitude. To prevent a clipping from occurring when converting the radio frequency signal s(t) into an optical signal p(t), a bias current to LD5 is chosen to be sufficiently large as indicated by $I_1$, for example. At this time, a mean optical output power $P_1$ from LD5 assumes a high value. A number of received radio frequency signal channels which can be multiplexed by a high sensitivity receiver fluctuates with the variation of communication traffic with time, causing the maximum amplitude of the radio frequency signal s(t) to vary. When the maximum amplitude of the radio frequency signal s(t) is small as illustrated in Fig. 26B, a bias current to LD5 is chosen to be a small current value $I_2$, for

example. In this instance, the mean optical output power of LD5 can be reduced to $P_2$. In this manner, the heat value of LD5 can be reduced, reducing the load on the cooling means 9, and at the same time, the aging effect of LD5 can be retarded than when it is always operating with a high bias current and a high mean optical output power. This bias current control of LD5 is applicable to embodiments shown in Figs. 5, 8 to 16 and 24, and is also applicable to the embodiment shown in Figs. 17 to 22. In this instance, as indicated in dotted lines in Fig. 25, a distributor 11 is inserted between the ~~synthesizer~~ combiner 15 and LD5 to allow an output signal from the ~~synthesizer~~ combiner 15 to be input to the distributor 11.

Please amend the paragraph at page 35, lines 3-8, as follows:

When the high sensitivity receiver is installed outdoors, a lightening surge protector is inserted within the casing 7 between the antenna feeder line 2 or 2a to 2b and RXF3, or between the antenna feeder lines 2a to 2b and the reception phase shifter 14 or the phase shifter ~~synthesizer~~ combiner 16 and on any power feeder lines (not shown) feeding respective devices in order to avoid any fault which is attributable to a lightening discharge.

Please amend the paragraph at page 35, lines 9-21, as follows:

The high sensitivity receiver according to the present invention is robust against a change in the environmental temperature and remains to be a low loss and a low noise while securing a sufficient dynamic range DR of the optical transmission assembly if it is installed outdoors. By confining the reception bandpass filter, the low noise reception amplifier and LD, and any phase shifter, ~~synthesizer~~ combiner or phase shifter ~~synthesizer~~ combiner for the array antenna arrangement, within a single heat shielding box to be cooled, the provision of electric cables which are used for signal connection between heat shielding boxes which would be otherwise required when these devices are confined in separate heat shielding boxes

can be omitted while simultaneously avoiding a heat flow into each heat shielding box through such electric cable and a resulting increase in the load upon cooling means, thus allowing a compact and economic construction of the entire high sensitivity receiver.